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Watanabe et al.

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(45) **Date of Patent:** **Dec. 24, 2013**

(54) **SHEET IDENTIFICATION DEVICE, IMAGE FORMING APPARATUS, AND COMPUTER READABLE MEDIUM**

(75) Inventors: **Kiyoshi Watanabe**, Kanagawa (JP); **Kiminobu Tsutada**, Kanagawa (JP); **Hiroyuki Tamai**, Kanagawa (JP); **Hiroaki Magaribuchi**, Kanagawa (JP)

(73) Assignee: **Fuji Xerox Co., Ltd.**, Tokyo (JP)

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B65H 5/26 (2006.01)
B65H 7/02 (2006.01)

(52) **U.S. Cl.**
USPC **271/9.01**; 271/9.06; 271/259; 271/258.03; 271/265.02

(58) **Field of Classification Search**
USPC 271/9.01, 9.06, 258.01, 259, 258.03, 271/265.01, 265.02
See application file for complete search history.

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Primary Examiner — David H Bollinger
(74) *Attorney, Agent, or Firm* — Sughrue Mion, PLLC

(57) **ABSTRACT**

A sheet identification device includes plural detecting units, an estimating unit, and an output unit. The plural detecting units are provided along a transport path along which a sheet is transported by a transport unit, and detect passing of the sheet. The estimating unit estimates a length in a transport direction of the sheet as a detection target on the basis of individual detection results generated by the plural detecting units. The output unit outputs, if the length estimated by the estimating unit on the basis of at least one of the detection results is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported.

13 Claims, 9 Drawing Sheets

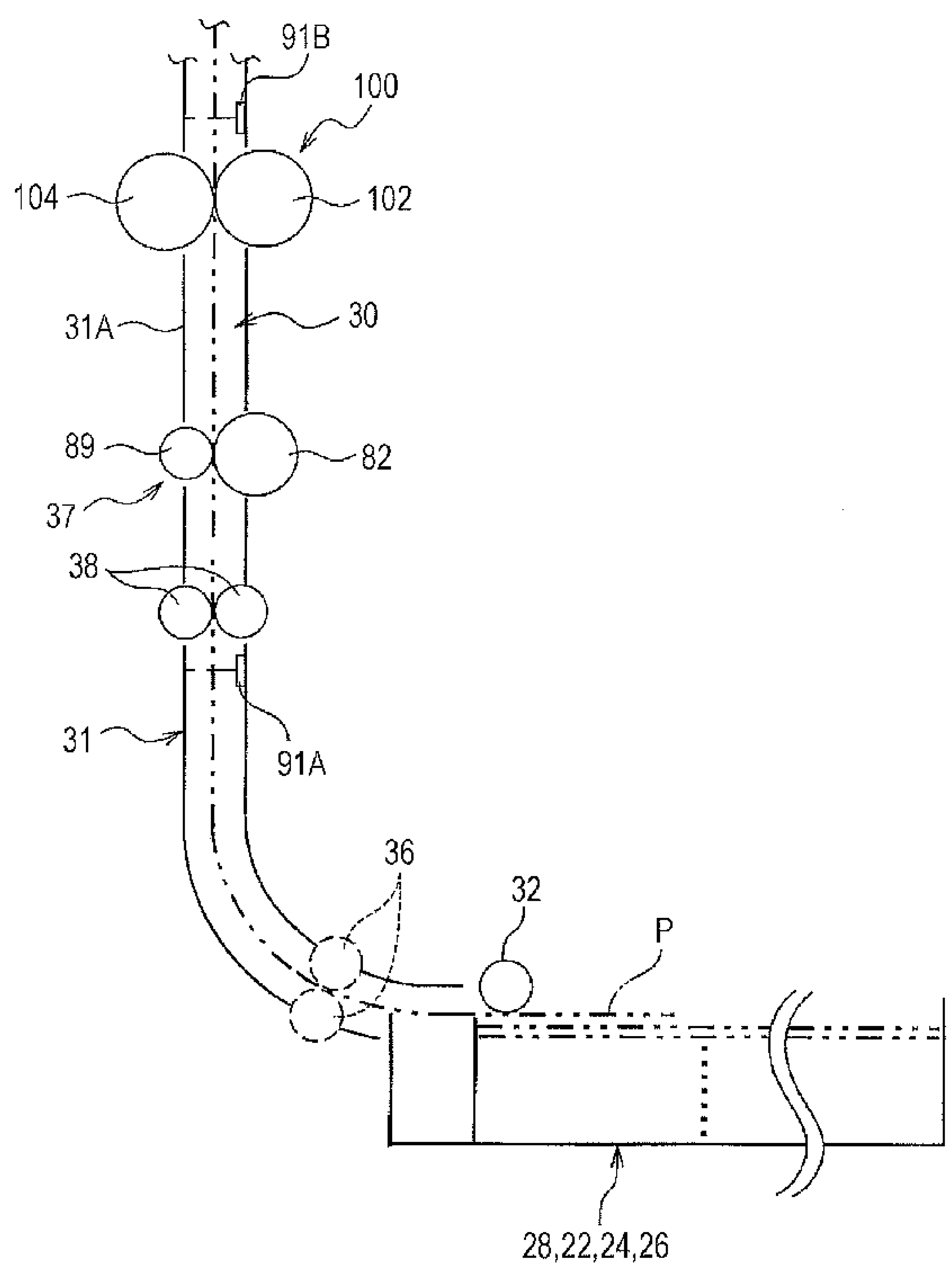


FIG. 1

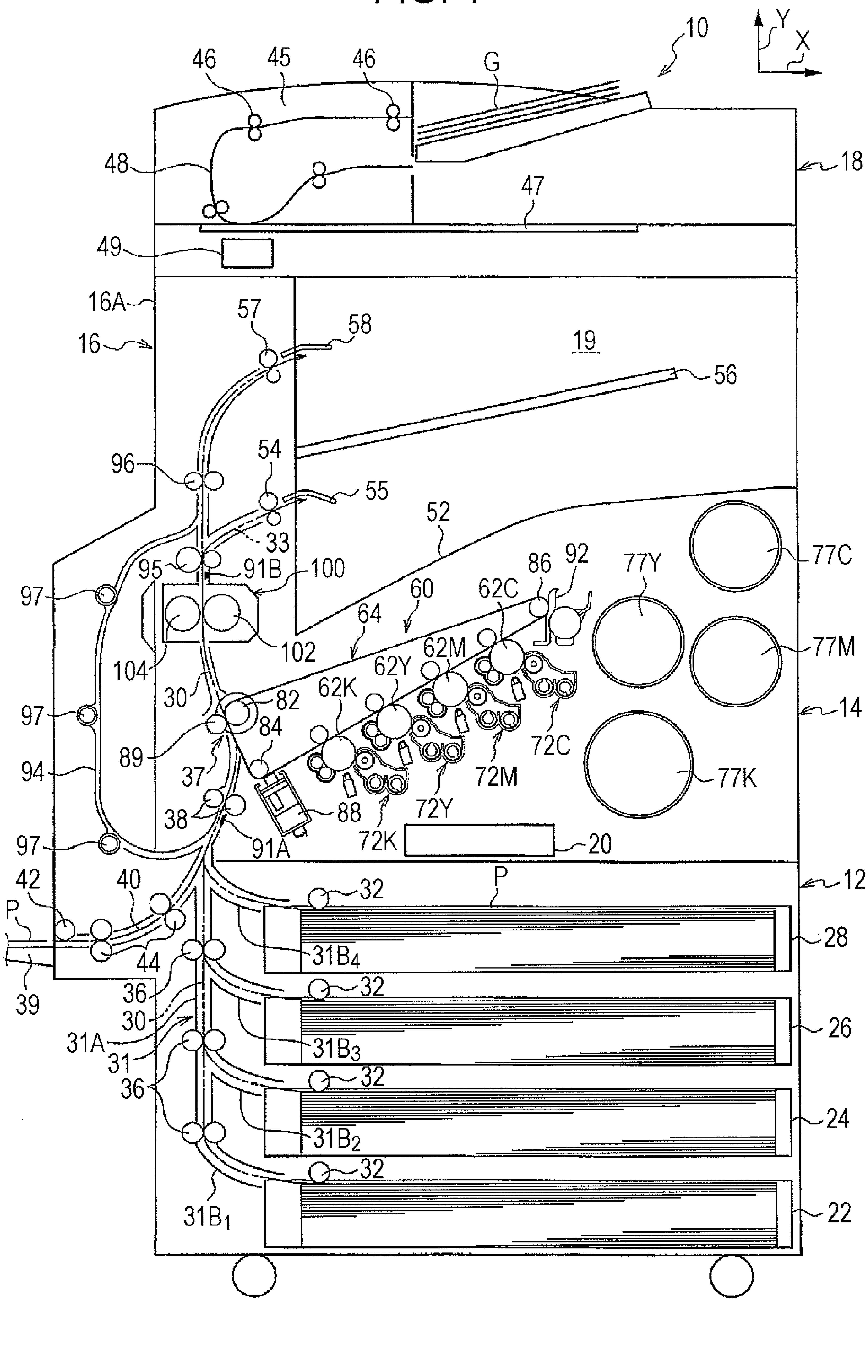

10
Y
X
46
45
46
G
18
48
47
49
16A
16
57
58
19
56
96
54
55
52
33
95
91B
100
97
86
92
77Y
77C
60
62C
64
104
102
62M
77M
62Y
30
82
62K
97
89
84
72C
14
94
37
72M
38
88
72Y
97
91A
72K
20
42
40
32
P
12
P
28
44
31B4
39
36
32
30
31A
26
31
31B3
36
32
24
31B2
32
31B1
22

FIG. 2

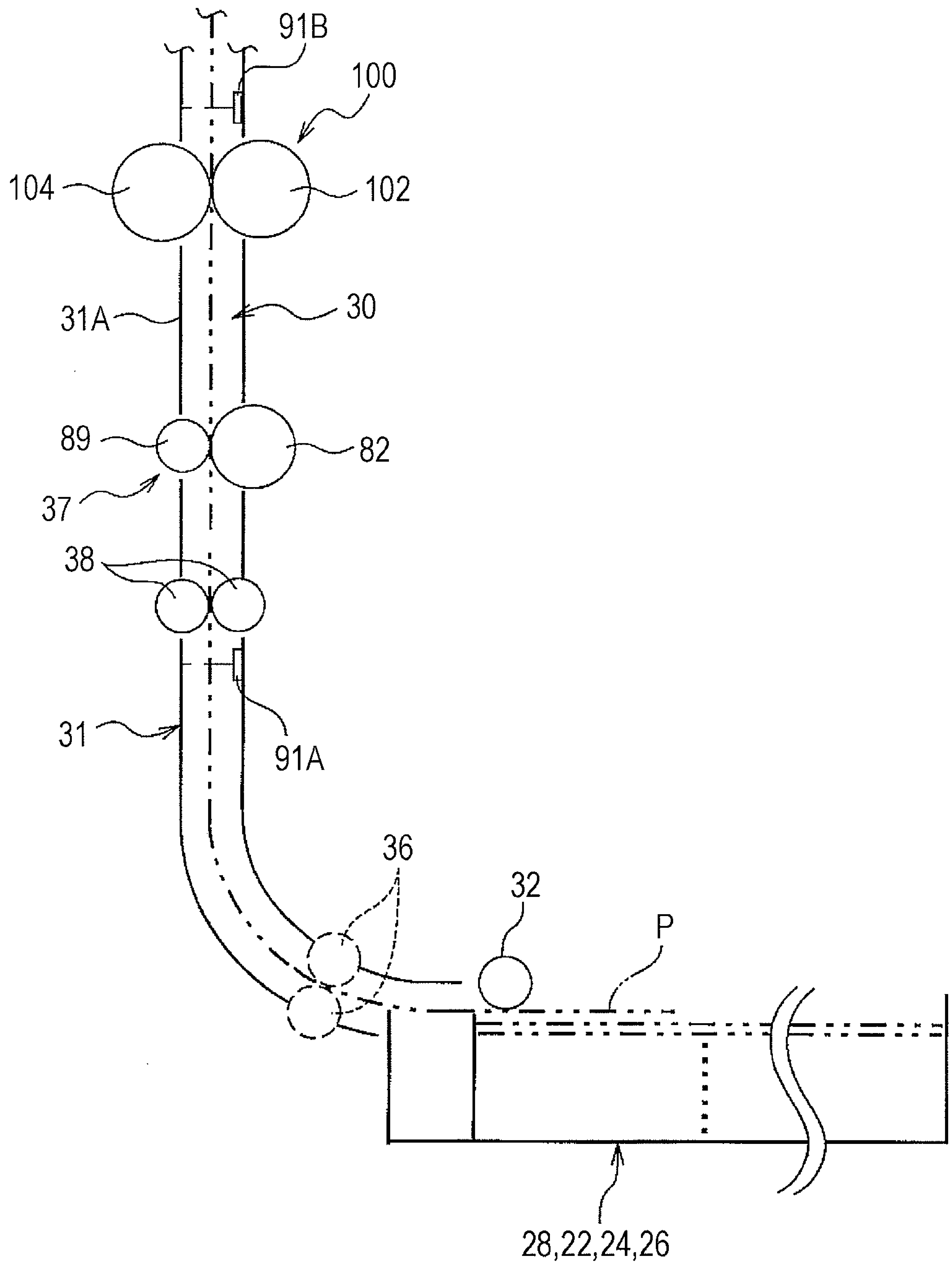


FIG. 3

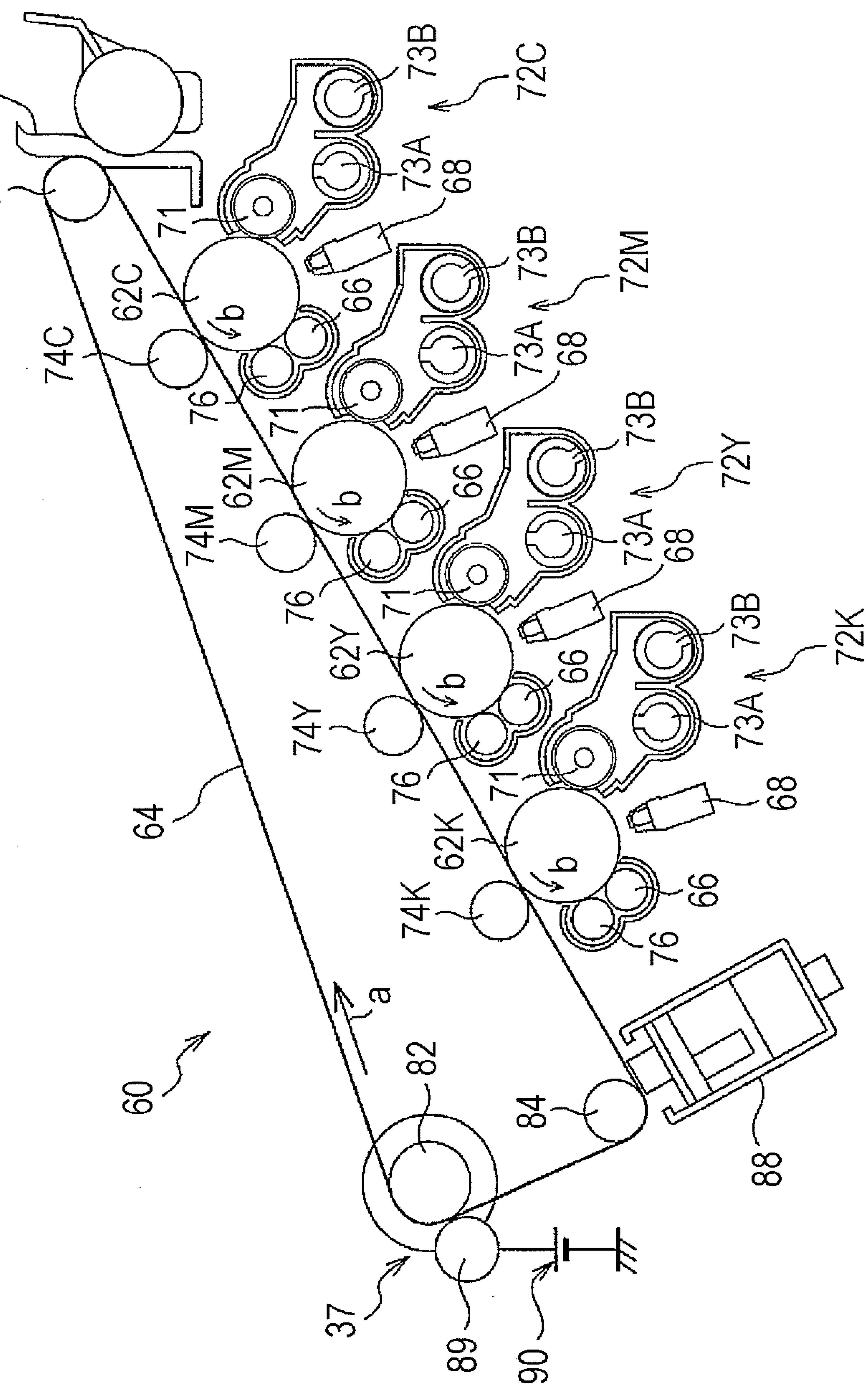

92
86
73B
72C
73A
68
71
62C
66
73B
72M
74C
76
73A
68
71
73B
72Y
62M
66
74M
73A
68
76
71
73B
72K
62Y
66
74Y
76
73A
71
68
64
62K
66
74K
76
a
60
82
84
88
37
89
90

FIG. 4

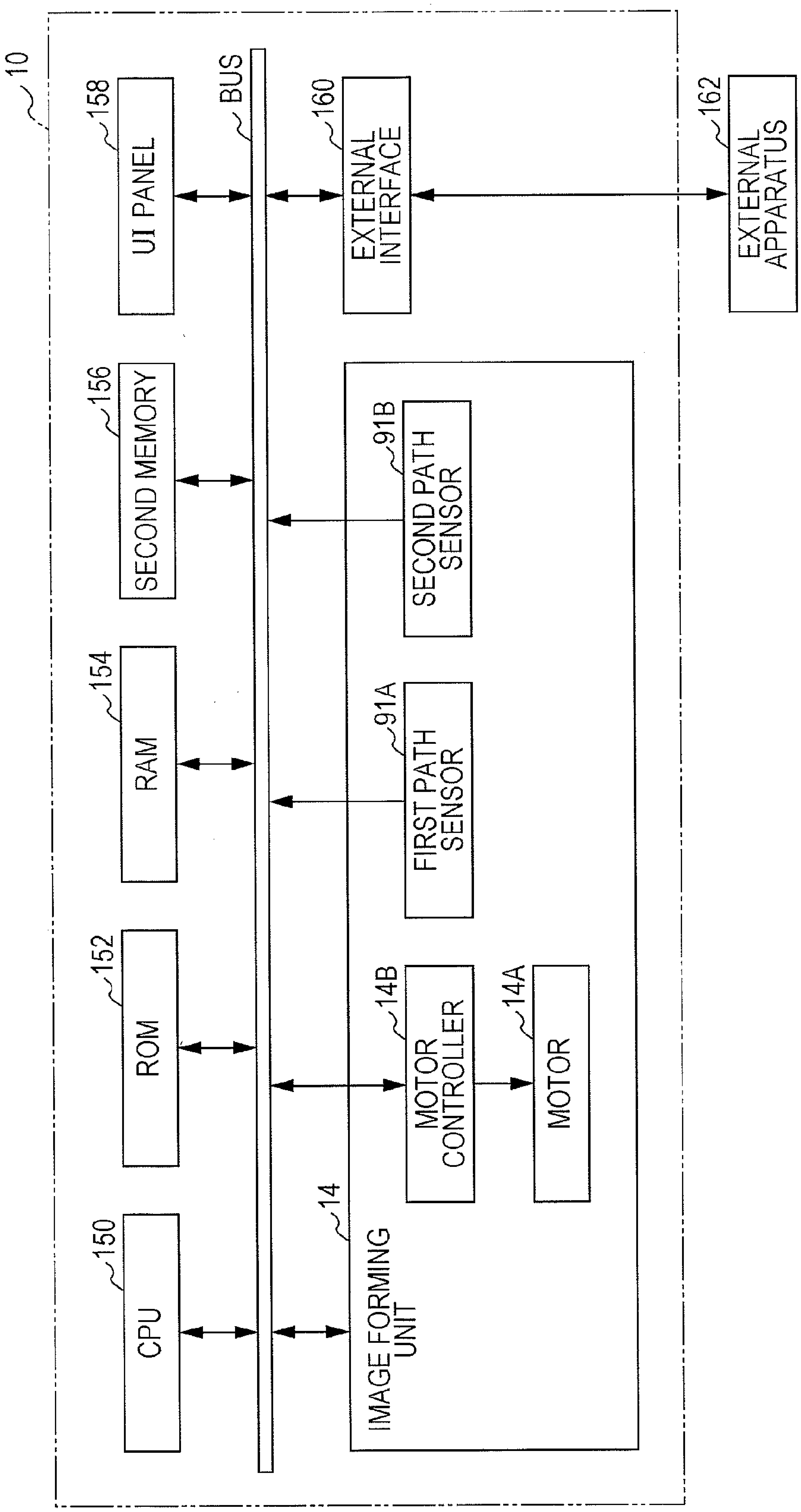
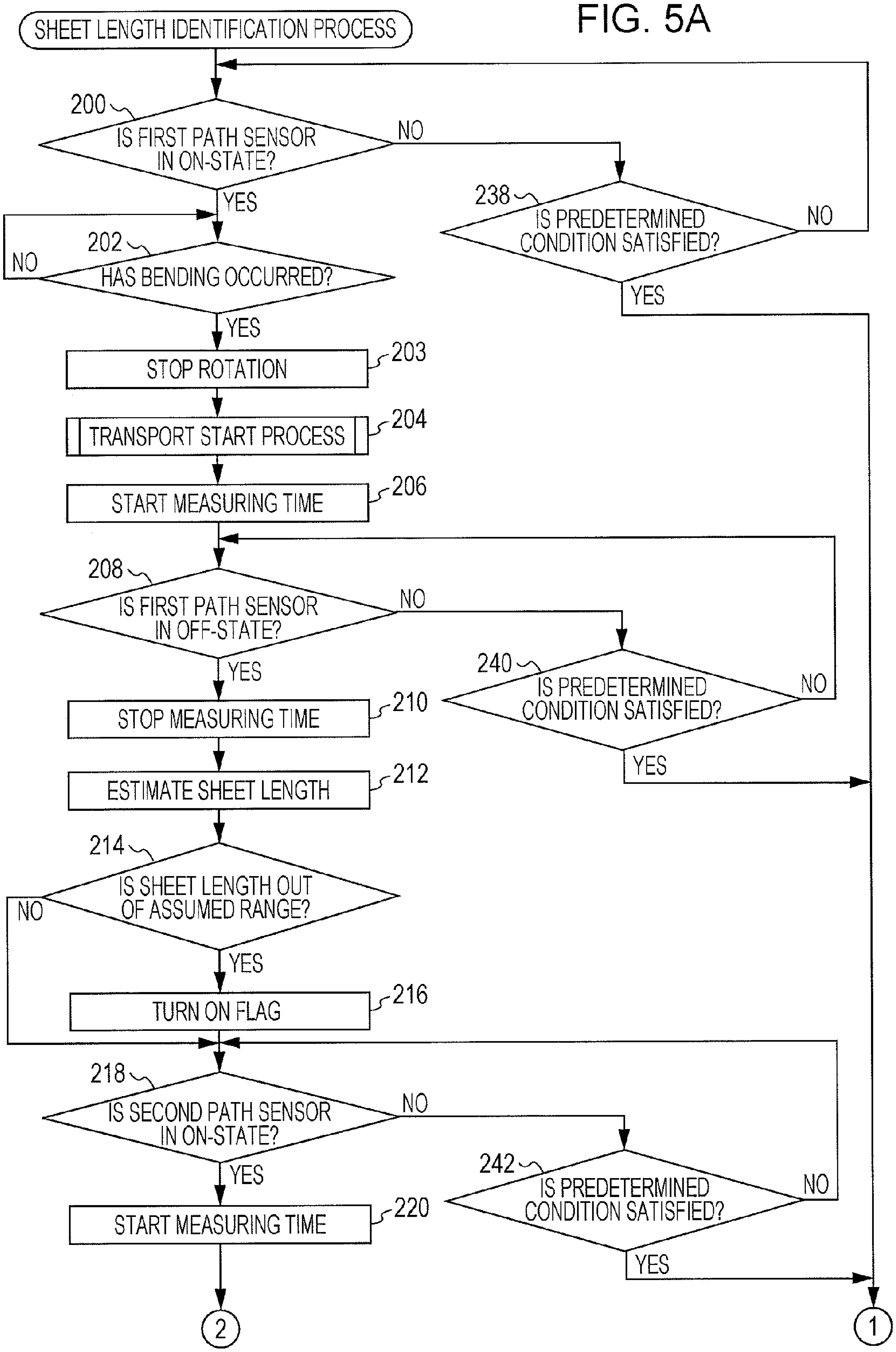

10
UI PANEL
158
BUS
EXTERNAL INTERFACE
160
EXTERNAL APPARATUS
162
SECOND MEMORY
156
SECOND PATH SENSOR
91B
RAM
154
FIRST PATH SENSOR
91A
ROM
152
MOTOR CONTROLLER
14B
MOTOR
14A
CPU
150
IMAGE FORMING UNIT
14

FIG. 5A



SHEET LENGTH IDENTIFICATION PROCESS
200
IS FIRST PATH SENSOR IN ON-STATE?
NO
YES
238
IS PREDETERMINED CONDITION SATISFIED?
NO
YES
202
HAS BENDING OCCURRED?
NO
YES
STOP ROTATION
203
TRANSPORT START PROCESS
204
START MEASURING TIME
206
208
IS FIRST PATH SENSOR IN OFF-STATE?
NO
YES
240
IS PREDETERMINED CONDITION SATISFIED?
NO
YES
STOP MEASURING TIME
210
ESTIMATE SHEET LENGTH
212
214
IS SHEET LENGTH OUT OF ASSUMED RANGE?
NO
YES
TURN ON FLAG
216
218
IS SECOND PATH SENSOR IN ON-STATE?
NO
YES
242
IS PREDETERMINED CONDITION SATISFIED?
NO
YES
START MEASURING TIME
220
2
1

FIG. 5B

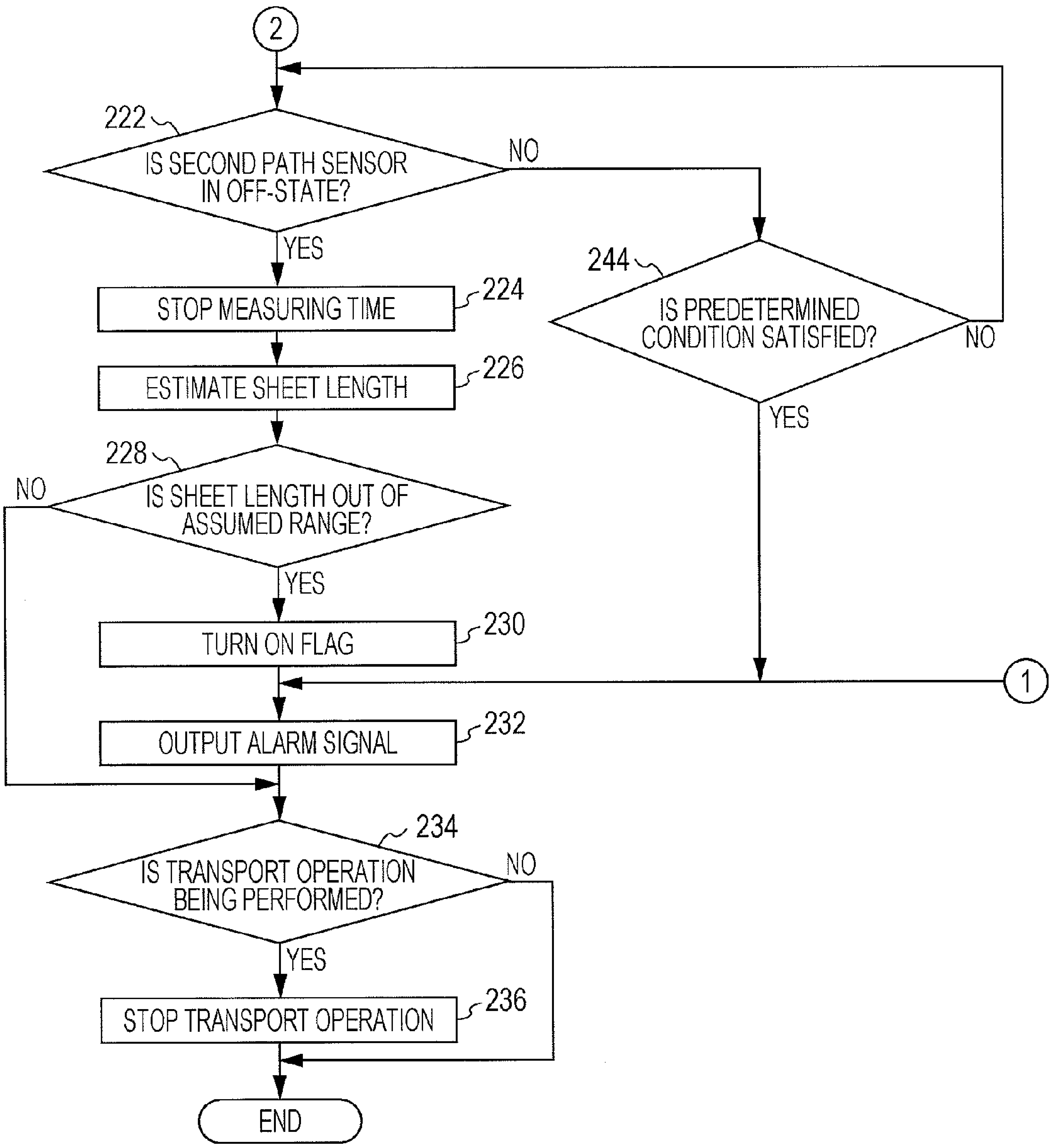

2
222
IS SECOND PATH SENSOR IN OFF-STATE?
NO
YES
STOP MEASURING TIME
224
244
IS PREDETERMINED CONDITION SATISFIED?
NO
ESTIMATE SHEET LENGTH
226
YES
228
NO
IS SHEET LENGTH OUT OF ASSUMED RANGE?
YES
TURN ON FLAG
230
1
OUTPUT ALARM SIGNAL
232
234
IS TRANSPORT OPERATION BEING PERFORMED?
NO
YES
STOP TRANSPORT OPERATION
236
END

FIG. 6

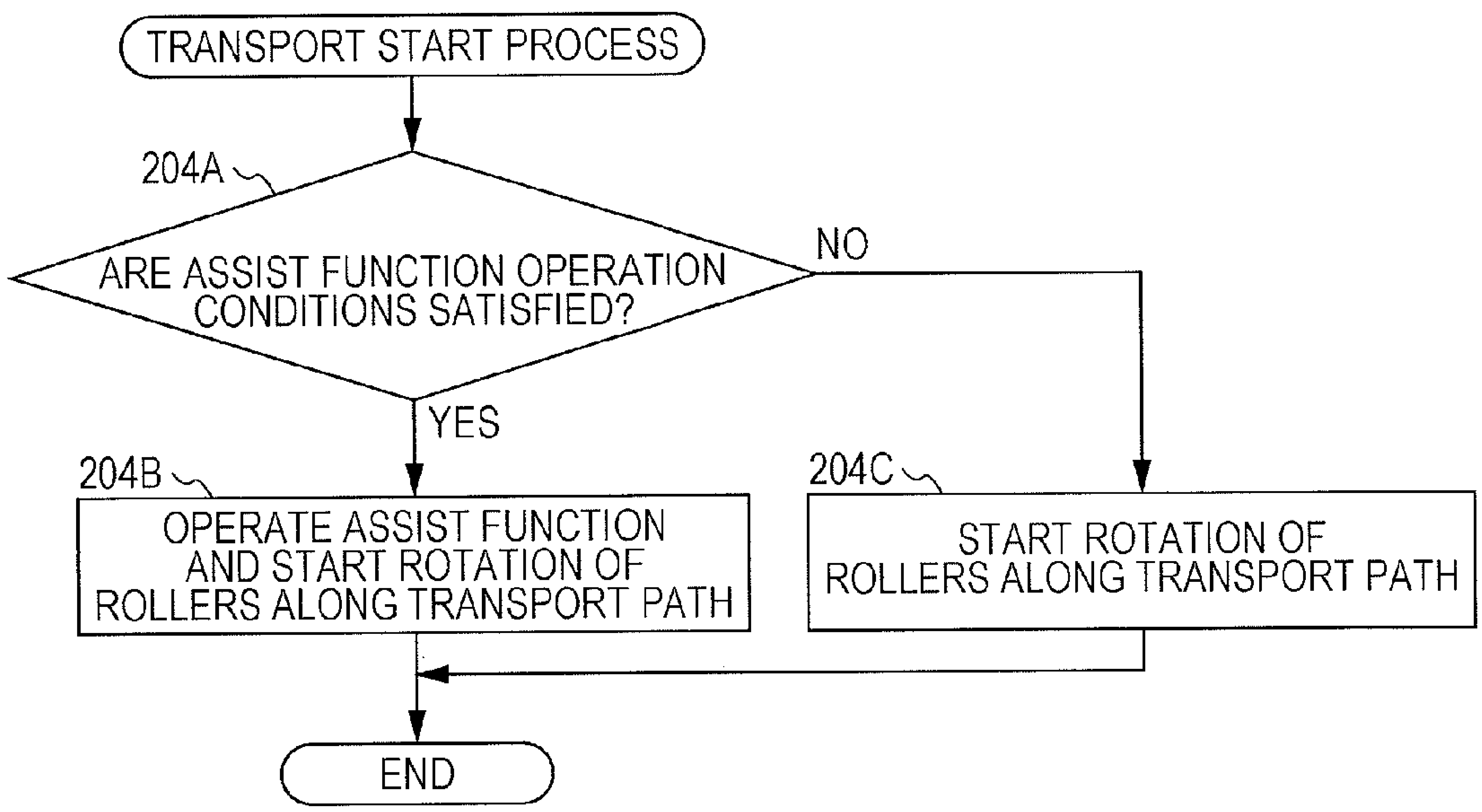

TRANSPORT START PROCESS
204A
ARE ASSIST FUNCTION OPERATION CONDITIONS SATISFIED?
NO
YES
204B
OPERATE ASSIST FUNCTION AND START ROTATION OF ROLLERS ALONG TRANSPORT PATH
204C
START ROTATION OF ROLLERS ALONG TRANSPORT PATH
END

FIG. 7A

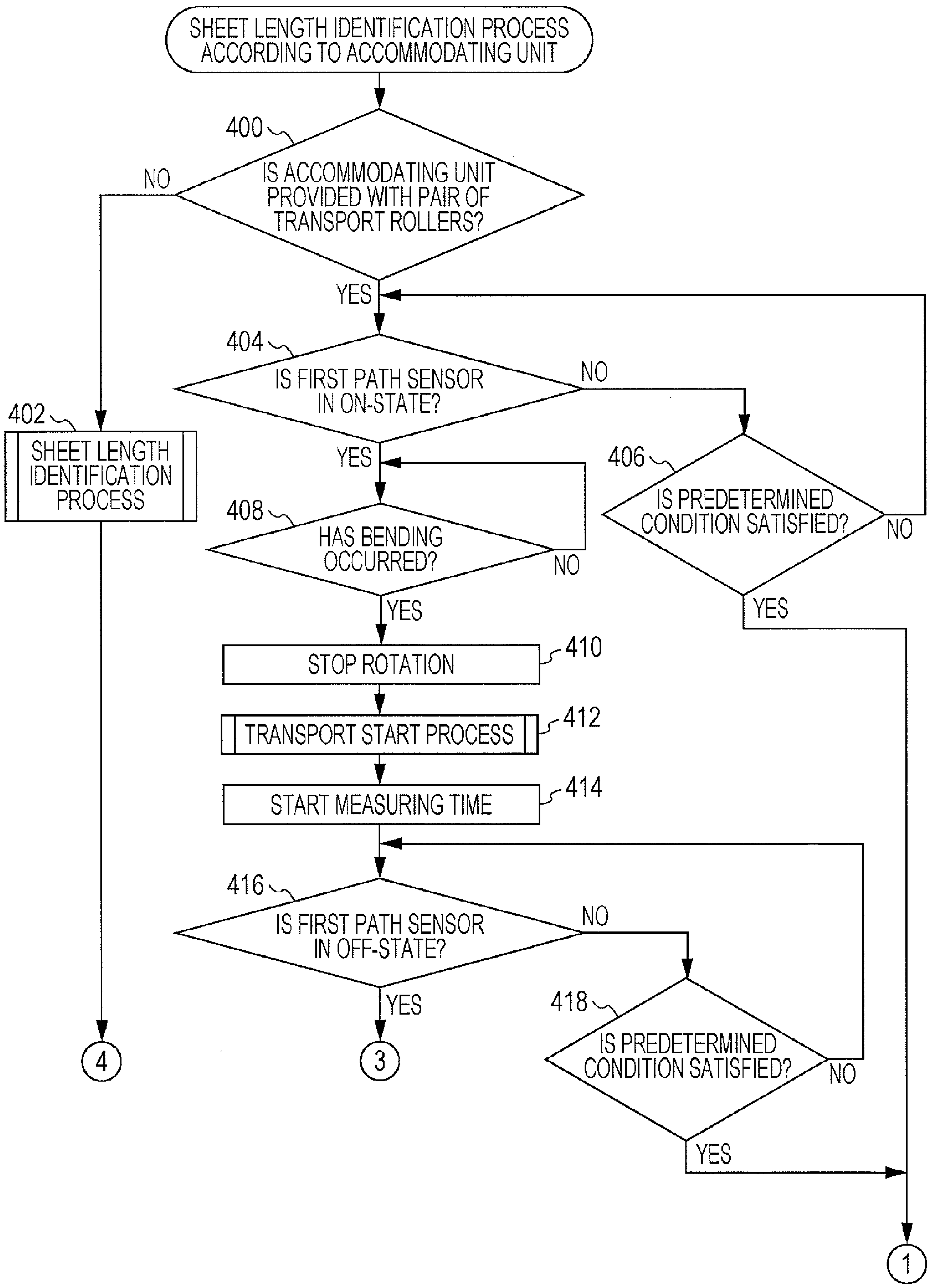
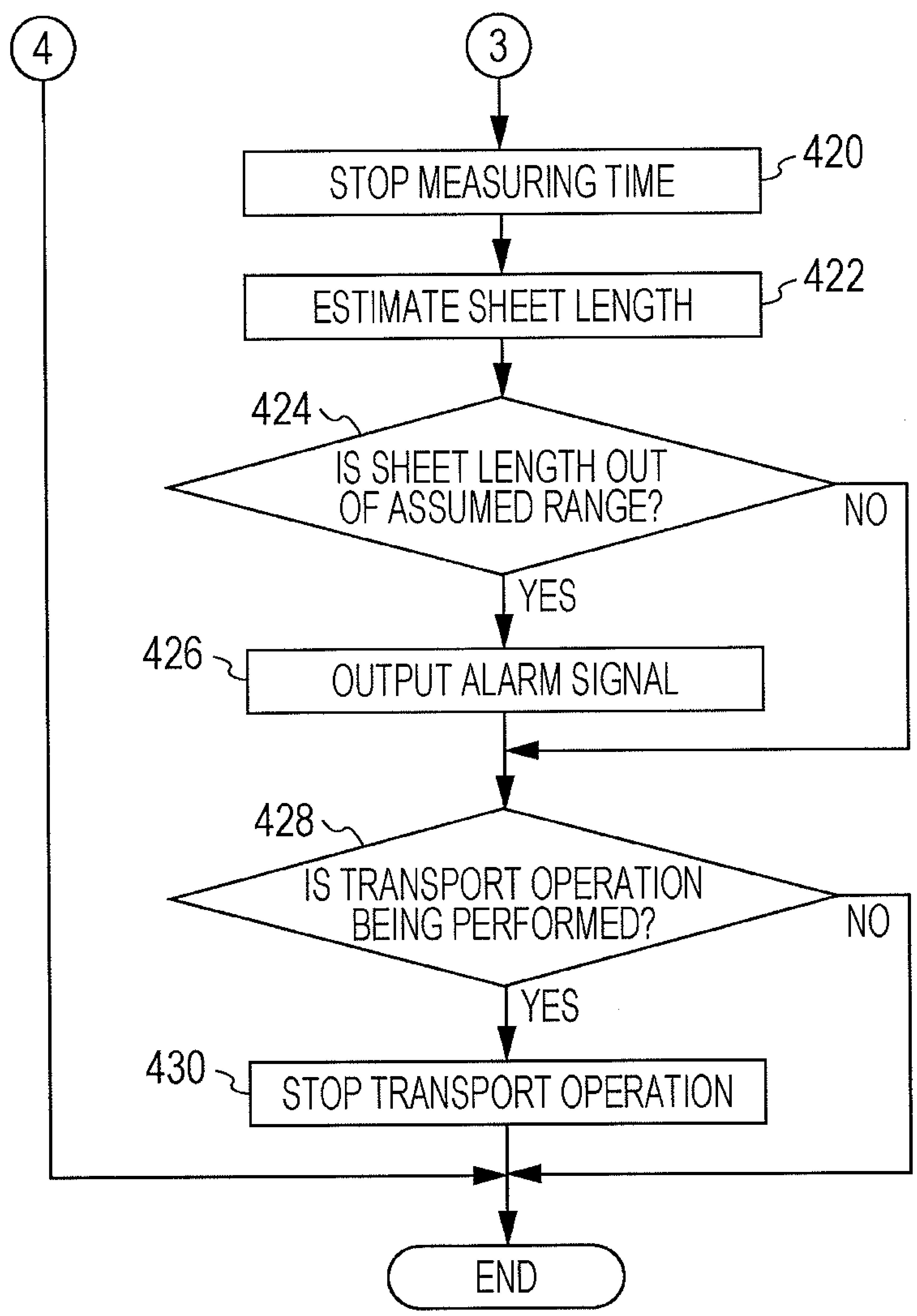

SHEET LENGTH IDENTIFICATION PROCESS ACCORDING TO ACCOMMODATING UNIT
400
IS ACCOMMODATING UNIT PROVIDED WITH PAIR OF TRANSPORT ROLLERS?
NO
YES
402
SHEET LENGTH IDENTIFICATION PROCESS
404
IS FIRST PATH SENSOR IN ON-STATE?
NO
YES
406
IS PREDETERMINED CONDITION SATISFIED?
NO
YES
408
HAS BENDING OCCURRED?
NO
YES
410
STOP ROTATION
412
TRANSPORT START PROCESS
414
START MEASURING TIME
416
IS FIRST PATH SENSOR IN OFF-STATE?
NO
YES
418
IS PREDETERMINED CONDITION SATISFIED?
NO
YES
4
3
1

FIG. 7B


4
3
STOP MEASURING TIME
420
ESTIMATE SHEET LENGTH
422
424
IS SHEET LENGTH OUT OF ASSUMED RANGE?
NO
YES
426
OUTPUT ALARM SIGNAL
428
IS TRANSPORT OPERATION BEING PERFORMED?
NO
YES
430
STOP TRANSPORT OPERATION
END

SHEET IDENTIFICATION DEVICE, IMAGE FORMING APPARATUS, AND COMPUTER READABLE MEDIUM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2011-126291 filed Jun. 6, 2011.

BACKGROUND

(i) Technical Field

The present invention relates to a sheet identification device, an image forming apparatus, and a computer readable medium.

SUMMARY

According to an aspect of the invention, there is provided a sheet identification device including plural detecting units, an estimating unit, and an output unit. The plural detecting units are provided along a transport path along which a sheet is transported by a transport unit, and detect passing of the sheet. The estimating unit estimates a length in a transport direction of the sheet as a detection target on the basis of individual detection results generated by the plural detecting units. The output unit outputs, if the length estimated by the estimating unit on the basis of at least one of the detection results is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiments of the present invention will be described in detail based on the following figures, wherein:

FIG. **1** is a side cross-sectional view illustrating an example of a configuration of an image forming apparatus according to an exemplary embodiment of the present invention;

FIG. **2** is a schematic view illustrating an example of disposition of a first path sensor and a second path sensor according to the exemplary embodiment;

FIG. **3** is a diagram illustrating an example of a configuration of an image forming part according to the exemplary embodiment;

FIG. **4** is a block diagram illustrating a configuration of an electric system of the image forming apparatus according to the exemplary embodiment;

FIGS. **5**A and **5**B illustrate a flowchart of a process of a sheet length identification process program according to a first exemplary embodiment of the present invention;

FIG. **6** is a flowchart illustrating a process of a transport start process program according to the first exemplary embodiment; and

FIGS. **7**A and **7**B illustrate a flowchart of a process of a sheet length identification process program according to an accommodating unit according to a second exemplary embodiment of the present invention.

DETAILED DESCRIPTION

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the drawings.

First Exemplary Embodiment

FIG. **1** is a side cross-sectional view of an image forming apparatus **10** according to a first exemplary embodiment of the present invention. The image forming apparatus **10** includes a sheet accommodating unit **12**, an image forming unit **14**, an output unit **16**, a document reader **18**, and a controller **20**, which are disposed from the lower side toward the upper side in the vertical direction in a front view of FIG. **1** (Y direction shown in FIG. **1**). The sheet accommodating unit **12** accommodates sheets of recording paper P. The image forming unit **14** is provided above the sheet accommodating unit **12** and forms images on sheets of recording paper P fed from the sheet accommodating unit **12**. The output unit **16** is provided above and to the left of the image forming unit **14** by being integrated with the image forming unit **14**, and outputs sheets of recording paper P on which images have been formed. The document reader **18** is provided above the output unit **16** and reads a document G. The controller **20** is provided in the image forming unit **14** and controls the operations of the individual units of the image forming apparatus **10**. In the description given below, the vertical direction in a front view of FIG. **1** is referred to as a Y direction, and the horizontal direction is referred to as an X direction. Also, "right" and "left" mean right and left in a front view of the image forming apparatus **10**.

The sheet accommodating unit **12** includes a first accommodating unit **22**, a second accommodating unit **24**, a third accommodating unit **26**, and a fourth accommodating unit **28** arranged along the Y direction, which accommodate sheets of recording paper P of different sizes. Each of the first accommodating unit **22**, the second accommodating unit **24**, the third accommodating unit **26**, and the fourth accommodating unit **28** (hereinafter referred to as "accommodating unit(s)" when it is not necessary to distinguish between them) is provided with a feed roller **32** for feeding a sheet of recording paper P accommodated therein to a transport path **30**. The transport path **30** is defined by a plate-like chute **31** that guides a sheet of recording paper P fed by the feed roller **32** from the sheet accommodating unit **12** to the image forming unit **14** and the output unit **16**. The chute **31** includes a main chute **31**A and branch chutes **31**B_1 to **31**B_4. The main chute **31**A guides a sheet of recording paper P from the sheet accommodating unit **12** to the image forming unit **14**, and defines a backbone portion of the transport path **30**. The branch chutes **31**B_1 to **31**B_4 branch off from the main chute **31**A, receive sheets of recording paper P fed by the respective feed rollers **32** from the first to fourth accommodating units **22**, **24**, **26**, and **28**, respectively, and guide the sheets of recording paper P to the main chute **31**A. The branch chute **31**B_1 corresponds to the first accommodating unit **22**. The branch chute **31**B_2 corresponds to the second accommodating unit **24**. The branch chute **31**B_3 corresponds to the third accommodating unit **26**. The branch chute **31**B_4 corresponds to the fourth accommodating unit **28**. Thus, the inlets of sheets of recording paper P in the respective branch chutes **31**B_1 to **31**B_4 function as the inlet of the transport path **30**.

The main chute **31**A is provided with pairs of transport rollers **36**, which correspond to the respective outlets of the branch chutes **31**B_1 to **31**B_3. Each pair of transport rollers **36** is constituted by a pair of rollers that sandwich a sheet of recording paper P fed by the corresponding feed roller **32** and feed the sheet to the downstream side in a transport direction. The pair of transport rollers **36** having such a configuration temporarily stops a sheet of recording paper P fed by the feed roller **32** at a nip portion and feeds the sheet to the downstream side in the transport direction at a predetermined timing in accordance with control performed by the controller **20**.

On the other hand, no pair of transport rollers **36** is provided for the branch chute **31**B_4. Thus, a sheet of recording paper P fed by the feed roller **32** to the branch chute **31**B_4 is guided to the main chute **31**A by the driving force of the feed roller **32**, and is fed to the downstream side in the transport direction.

In the main chute **31**A, a pair of positioning rollers **38** is provided on the downstream side of the pairs of transport rollers **36** in the transport direction of a sheet of recording paper P. The pair of positioning rollers **38** temporarily stops a sheet of recording paper P and feeds the sheet to a downstream region (second transfer unit **37**) at a predetermined timing. The pair of positioning rollers **38** is disposed such that the peripheral surfaces of the rollers face each other and are in contact with each other. The pair of positioning rollers **38** sandwich a sheet of recording paper P and are rotated by receiving a driving force from a motor **14**A (see FIG. **4**), thereby feeding the sheet to the downstream side of the transport path **30**. The pair of positioning rollers **38** are configured so as not to be rotated by the weight of the pair of positioning rollers **38** and the weight of a gear that connects the pair of positioning rollers **38** and the drive shaft of the motor **14**A, even if the leading end of a sheet of recording paper P fed by the feed roller **32** comes into contact with the nip portion and is pushed.

The image forming unit **14** includes a casing **16**A, which serves as a body of the apparatus. The casing **16**A is configured so that the upper left portion of the image forming unit **14** protrudes toward the upper side with respect to the upper center portion and the upper right portion in a front view of the image forming apparatus **10**. The left end portion of the document reader **18** is connected to the upper end of the output unit **16**. Accordingly, the image forming apparatus **10** has an output region **19** surrounded by the upper surface of the image forming unit **14**, the lower surface of the document reader **18**, and the right surface of the output unit **16**. Sheets of recording paper P from the output unit **16** are output and stacked in the output region **19**.

An auxiliary transport path **40** is provided on the opposite side of the transport path **30** for the image forming unit **14** to the fourth accommodating unit **28**. A sheet of recording paper P fed from a foldable manual sheet feeder **39**, which is provided on the left surface of the image forming apparatus **10** in a front view of the image forming apparatus **10**, is transported along the auxiliary transport path **40** to the transport path **30**. The auxiliary transport path **40** is provided with a feed roller **42**, which feeds a sheet of recording paper P fed from the manual sheet feeder **39** to the auxiliary transport path **40**, and plural pairs of transport rollers **44**, which are provided on the downstream side of the feed roller **42** and which transport sheets of recording paper P one by one. The downstream-side end of the auxiliary transport path **40** is connected to the transport path **30**.

Also, a fixing device **100** is provided on the downstream side of the second transfer unit **37** along the transport path **30** in the image forming unit **14**. The fixing device **100** includes a fixing roller **102** for heating a developer on a sheet of recording paper P, and a pressure roller **104** for pressing the sheet against the fixing roller **102**. The fixing device **100** is configured so that, after a sheet of recording paper P has passed through a nip portion N, where the fixing roller **102** is in contact with the pressure roller **104**, a developer is fused and fixed, whereby a developer image is fixed onto the sheet. In the image forming apparatus **10** according to the first exemplary embodiment, a two-component developer including toner and carrier is adopted as a developer. Hereinafter, the developer is referred to as "toner".

The image forming unit **14** includes a first path sensor **91**A and a second path sensor **91**B that detect passing of a sheet of recording paper P in a predetermined region of the transport path **30**. In the image forming apparatus **10**, various types of control (for example, control of the timing to perform transfer, timing to start/stop rotation of each roller, and timing to perform a fixing process) is performed on the basis of detection results generated by the first path sensor **91**A and the second path sensor **91**B.

FIG. **2** schematically illustrates an example in which the first path sensor **91**A and the second path sensor **91**B according to the first exemplary embodiment are disposed along the transport path **30**. As illustrated in FIG. **2**, the pair of transport rollers **36**, the pair of positioning rollers **38**, the second transfer unit **37**, and the fixing device **100** are disposed along the transport path **30** in this order from the upstream side toward the downstream side in the transport direction. The first path sensor **91**A is disposed on the upstream side of the pair of positioning rollers **38** and on the downstream side of the pair of transport rollers **36** in the transport direction along the transport path **30**. On the other hand, the second path sensor **91**B is disposed on the downstream side of the fixing device **100** along the transport path **30**. The first path sensor **91**A and the second path sensor **91**B are normally in an ON-state, and shift to an OFF-state while a sheet of recording paper P is passing through a detection target region. In other words, the first path sensor **91**A and the second path sensor **91**B are in an ON-state when no sheet of recording paper P exists in the detection target region (non-passing period of a sheet of recording paper P), and are in an OFF-state when a sheet of recording paper P exists in the detection target region (passing period of a sheet of recording paper P). A reflective photo interrupter is used for both the first path sensor **91**A and second path sensor **91**B according to the first exemplary embodiment. Alternatively, a transparent photo interrupter may be used therefor, and any types of sensor may be used as long as the sensor detects passing of a sheet of recording paper P (for example, a sensor that detects the leading end and the trailing end of a sheet of recording paper P).

As illustrated in FIGS. **1** and **3**, an image forming part **60** is provided at the center of the image forming unit **14**. The image forming part **60** serves as a forming part for forming a toner image on a sheet of recording paper P by mixing toners of respective colors of black (K), yellow (Y), magenta (M), and cyan (C). The image forming part **60** includes photoconductor drums **62**K, **62**Y, **62**M, and **62**C for holding electrostatic latent images, which correspond to toners of respective colors of K, Y, M, and C. In the description given below, when it is necessary to distinguish K, Y, M, and C from one another, corresponding one of K, Y, M, and C will be attached after reference numeral. When it is not necessary to distinguish them, K, Y, M, and C will be omitted.

The photoconductor drums **62**K, **62**Y, **62**M, and **62**C are arranged in this order toward the upper right side in FIG. **3**, are rotated in the direction indicated by an arrow b (counterclockwise in the figure), and hold an electrostatic latent image formed through irradiation on their peripheral surfaces. Also, a charging roller **66**, a light-emitting diode (LED) head **68**, a developing device **72**, an intermediate transfer belt **64**, and a cleaning roller **76** are provided in this order along the arrow-b direction around each of the photoconductor drums **62**K, **62**Y, **62**M, and **62**C.

The charging roller **66** has a configuration in which plural layers including an electro-conductive elastic layer, an intermediate layer, and a surface resin layer (not illustrated) are formed around a shaft made of stainless steel, for example. The shaft of the charging roller **66** is rotatable so that the charging roller **66** is rotated in conjunction with the photoconductor drum **62**, with the peripheral surface of the charging roller **66** being in contact with the surface layer of the photoconductor drum **62**. The charging roller **66** causes the peripheral surface of the photoconductor drum **62** to be charged through discharge that occurs when a voltage is applied from a voltage applying unit (not illustrated).

The LED head **68** causes the peripheral surface of the photoconductor drum **62** charged by the charging roller **66** to be irradiated with (exposed to) light corresponding to the color of toner, thereby forming an electrostatic latent image. Alternatively, a method for scanning laser light for four colors of K, Y, M, and C in common using a polygon mirror may be used as a method for exposing the photoconductor drums **62**.

The developing device **72** includes a developing roller **71** that supplies toner to an electrostatic latent image formed on the photoconductor drum **62** and forms a toner image, and transport members **73**A and **73**B that transport toner to the developing roller **71** in a circulating manner.

The intermediate transfer belt **64** is an endless belt, is wound around a belt transport roller **82** provided in the second transfer unit **37**, a belt transport roller **84** provided below and to the right of the belt transport roller **82**, and a driving roller **86** that is provided above and to the right of the belt transport roller **82** and is driven by a motor (not illustrated), and is supported so as to be rotatably moved in the direction indicated by an arrow a (clockwise in the figure). The outer surface of the intermediate transfer belt **64** serves as a transfer surface onto which a toner image is to be transferred. The peripheral surfaces of the photoconductor drums **62**K, **62**Y, **62**M, and **62**C are in contact with a transfer surface of the intermediate transfer belt **64**, the transfer surface extending from the driving roller **86** to the belt transport roller **84**.

First transfer rollers **74** (**74**K, **74**Y, **74**M, and **74**C) are provided on the opposite side to the photoconductor drums **62**K, **62**Y, **62**M, and **62**C, with the intermediate transfer belt **64** interposed therebetween. The first transfer rollers **74** are in contact with the inner surface of the intermediate transfer belt **64**. When a voltage is applied to the first transfer rollers **74** from a voltage applying unit (not illustrated), the first transfer rollers **74** perform first transfer, thereby transferring the toner images on the photoconductor drums **62** onto the transfer surface of the intermediate transfer belt **64** using a potential difference between the first transfer rollers **74** and the photoconductor drums **62** that are grounded. Accordingly, the individual toner images are transferred onto the intermediate transfer belt **64** in a superimposed manner while the intermediate transfer belt **64** makes a round.

Also, a toner density detection sensor **88** is provided on the opposite side to the belt transport roller **84**, with the intermediate transfer belt **64** interposed therebetween. The tonner density detection sensor **88** has a function of detecting the density of a toner image transferred onto the transfer surface of the intermediate transfer belt **64**. Furthermore, a cleaning member **92** is provided on the opposite side to the driving roller **86**, with the intermediate transfer belt **64** interposed therebetween. The cleaning member **92** removes residual toner that is left on the transfer surface of the intermediate transfer belt **64** after second transfer.

The second transfer unit **37** includes the belt transport roller **82** on which the intermediate transfer belt **64** is wound, and a second transfer roller **89**. The second transfer roller **89** serves as a transport unit and is provided on the opposite side to the belt transport roller **82**, with the intermediate transfer belt **64** interposed therebetween. The second transfer roller **89** is connected to a voltage applying unit **90** so that a voltage is applied thereto from the voltage applying unit **90**, and is configured so that the toner image on the intermediate transfer belt **64** is second transferred onto a sheet of recording paper P due to a potential difference between the belt transport roller **82** and the second transfer roller **89**.

As illustrated in FIG. **1**, toner cartridges **77**K, **77**Y, **77**M, and **77**C containing toners of K, Y, M, and C, respectively, are provided in an exchangeable manner to the right of the cleaning member **92** in the image forming unit **14**. Also, a duplex-printing transport path **94** is provided to the left of the transport path **30** in the image forming unit **14**. In the duplex-printing transport path **94**, a sheet of recording paper P is transported and reversed so as to form images on both sides of the sheet.

One end of the duplex-printing transport path **94** is connected between a pair of transport rollers **95** and a pair of transport rollers **96**. The pair of transport rollers **95** is provided on the downstream side of the fixing device **100** in the transport direction of a sheet of recording paper P along the transport path **30**. The pair of transport rollers **96** is provided on the downstream side of the pair of transport rollers **95**, and the rotation direction thereof may be switched. The other end of the duplex-printing transport path **94** is connected to the upstream side of the pair of positioning rollers **38**. Also, the duplex-printing transport path **94** is provided with plural transport rollers **97** that transport a sheet of recording paper P fed from the pair of transport rollers **96** toward the pair of positioning rollers **38**. Accordingly, when images are to be formed on both sides, a sheet of recording paper P to which a toner image has been fixed onto the front side by the fixing device **100** is fed to the duplex-printing transport path **94** due to a reverse rotation of the pair of transport rollers **96** and a path switching member (not illustrated), and is fed again to the pair of positioning rollers **38**, so that the front and back sides of the sheet of recording paper P are reversed.

Lower output rollers **54** are provided on the downstream side of the pair of transport rollers **95** in the output unit **16**. The lower output rollers **54** are disposed along a transport path **33**, which branches off from the transport path **30** to the output region **19** side, and output a sheet of recording paper P onto a lower table **52** provided in an upper section of the image forming unit **14**. A lower detecting unit **55** is provided at a position next to the lower output rollers **54**. The lower detecting unit **55** detects the height of sheets of recording paper P stacked on the lower table **52**. Also, upper output rollers **57** are provided on the downstream side of the pair of transport rollers **95** along the transport path **30** in the output unit **16**. The upper output rollers **57** output sheets of recording paper P onto an upper table **56**, which is provided above the lower table **52**. An upper detecting unit **58** is provided at a position next to the upper output rollers **57**. The upper detecting unit **58** detects the height of sheets of recording paper P stacked on the upper table **56**.

The document reader **18** includes a document transport device **45** that automatically transports sheets of a document G one by one, a platen glass **47** which is disposed below the document transport device **45** and on which one sheet of the document G is placed, and a document reading device **49** that reads the document G transported by the document transport device **45** or the document G placed on the platen glass **47**. The document transport device **45** includes an automatic transport path **48** along which plural pairs of transport rollers **46** are disposed. Part of the automatic transport path **48** is disposed so that a sheet of recording paper P passes over the platen glass **47**. The document reading device **49** is configured to read a document G that is transported by the document transport device **45** in the state of being stationary at the left end of the platen glass **47**, or to read a document G placed on the platen glass **47** while moving in the X direction.

FIG. **4** is a block diagram illustrating a configuration of an electric system of the image forming apparatus **10** according to this exemplary embodiment. As illustrated in FIG. **4**, the image forming apparatus **10** includes a central processing unit (CPU) **150** serving as an estimating unit and a controller, a read only memory (ROM) **152**, a random access memory (RAM) **154**, a second memory **156**, a user interface (UI) panel **158**, and an external interface **160**.

The ROM **152** functions as a memory that stores in advance a control program for controlling the operation of the image forming apparatus **10**, a sheet length identification process program described below, and various parameters. The RAM **154** is used as a working area or the like for executing various programs. The second memory **156** stores various pieces of information that are to be held even after the power switch of the apparatus is turned off. For example, a hard disk device or a flash memory is applied thereto. The UI panel **158** is constituted by a touch panel display or the like in which a transparent touch panel is superimposed on a display. Various pieces of information are displayed on the display screen of the display. Also, the UI panel **158** receives various pieces of information and instructions when the touch panel is touched by a user. The external interface **160** is connected to the external apparatus **162**, such as a personal computer, receives various pieces of information, such as image information representing an image that is to be formed on recording paper P, from the external apparatus **162**, and transmits various pieces of information, such as information representing the status of the image forming apparatus **10**, to the external apparatus **162**.

The image forming unit **14**, the CPU **150**, the ROM **152**, the RAM **154**, the second memory **156**, the UI panel **158**, and the external interface **160** are connected to one another via a system bus BUS. Thus, the CPU **150** accesses the ROM **152**, the RAM **154**, and the second memory **156**, displays various pieces of information on the UI panel **158**, recognizes operation instructions provided by a user to the UI panel **158**, receives various pieces of information from the external apparatus **162** via the external interface **160**, transmits various pieces of information to the external apparatus **162** via the external interface **160**, recognizes the operation status of the image forming unit **14**, and controls the operation of the image forming unit **14**.

The image forming unit **14** serving as an image forming unit includes, for example, the motor **14**A that generates a driving force for rotating various rollers for transporting a sheet of recording paper P, such as the feed rollers **32** serving as a feed unit, the pairs of transport rollers **36** serving as a supplying unit, the pairs of transport rollers **44**, **54**, **57**, **95**, and **96** serving as a transport unit, the pair of positioning rollers **38** serving as a transport unit, the fixing roller **102** serving as a transport unit, and the pressure roller **104** serving as a transport unit. Also, the image forming unit **14** includes a motor controller **14**B that is connected to the motor **14**A and controls driving of the motor **14**A, the first path sensor **91**A serving as a detecting unit, and the second path sensor **91**B serving as a detecting unit. The motor controller **14**B, the first path sensor **91**A, and the second path sensor **91**B are connected to one another via the system bus BUS. Thus, the CPU **150** controls the motor **14**A via the motor controller **14**B, recognizes the operation status of the motor **14**A via the motor controller **14**B, and receives signals output from the first path sensor **91**A and the second path sensor **91**B (ON signal representing an ON state and OFF signal representing an OFF state).

The image forming apparatus **10** according to the first exemplary embodiment has an assist function of assisting transport of a sheet of recording paper P by using the feed roller **32** in a case where the length in the transport direction of the sheet to be transported (hereinafter referred to as "sheet length") is equal to or larger than a predetermined length (for example, the length in the longitudinal direction of the A4 size).

The assist function is a function of assisting transport of a sheet of recording paper P while the sheet is being transported along the transport path **30** in order to suppress the occurrence of wrinkling or slipping of the sheet during transport. It is necessary that the following three conditions (i) to (iii) are satisfied in order to operate the assist function (hereinafter the three conditions are referred to as "assist function operation conditions").

(i) A sheet length equal to or larger than a predetermined length is set.

(ii) The leading end of a sheet of recording paper P is in contact with the pair of positioning rollers **38** the rotation of which is stopped.

(iii) The rotation of the feed roller **32** is stopped.

When the assist function operation conditions are satisfied, the assist function simultaneously starts the rotation of the pair of positioning rollers **38** and the feed roller **32** that are temporarily stopped, and continues the rotation of the feed roller **32** until a predetermined stop condition is satisfied (for example, a predetermined time period has elapsed as a time period for assisting transport of a sheet of recording paper P having a sheet length set by a user after the rotation of the pair of positioning rollers **38** and the feed roller **32** that are temporarily stopped has simultaneously started (after feeding to the downstream side of the pair of positioning rollers **38** has started)). The predetermined stop condition is a predetermined condition for determining that the trailing end of a sheet of recording paper P has passed the feed roller **32**, for example, a condition in which a predetermined time period (for example, 0.8 seconds) has elapsed from restart of transport of the sheet.

If the condition "a sheet length smaller than a predetermined length is set" is satisfied instead of condition (i), the assist function is not operated, and a normal transport operation is performed. Here, the "normal transport operation" means transporting a sheet of recording paper P by rotating the pair of positioning rollers **38** and the individual rollers disposed along the transport path **30**, not by rotating the feed roller **32**. In the image forming apparatus **10** according to the first exemplary embodiment, "setting of a sheet length" means determining a sheet length on the basis of the position of a side fence (not illustrated) provided in the accommodating unit that accommodates sheets of recording paper P as a target to be transported (target on which an image is to be formed) and that is specified via the UI panel **158**, and storing the determined sheet length in a predetermined storage region. Here, the "side fence" is a fence for specifying the length of sheets of recording paper P accommodated in the accommodating unit. The position of the side fence in the accommodating unit may be detected by using a sensor, such as a photo interrupter or a micro switch.

In the image forming apparatus **10** according to the first exemplary embodiment, a side fence is provided in each accommodating unit, but the side fence may not be provided in each accommodating unit. In that case, "setting of a sheet length" means providing accommodating units corresponding to individual sheet lengths of recording paper P, specifying any one of the accommodating units via the UI panel **158**, and storing the sheet length corresponding to the specified accommodating unit in a predetermined storage region.

Next, the operation of the image forming apparatus **10** according to this exemplary embodiment will be described.

First, an image formation process performed by the image forming apparatus **10** will be described.

After the image forming apparatus **10** has been activated, image data of individual colors of K, Y, M, and C is output from an image processing apparatus (not illustrated) or the outside to the corresponding LED heads **68** (see FIG. **3**). Subsequently, light is emitted from the LED heads **68** in accordance with the image data, the peripheral surfaces of the photoconductor drums **62** charged by the charging rollers **66** are exposed to the light, and electrostatic latent images corresponding to the image data of the respective colors are formed on the surfaces of the respective photoconductor drums **62**. The electrostatic latent images formed on the surfaces of the respective photoconductor drums **62** are developed into toner images by the respective developing devices **72**. Then, the toner images on the surfaces of the respective photoconductor drums **62** are sequentially transferred onto the intermediate transfer belt **64** by the first transfer rollers **74**.

On the other hand, a sheet of recording paper P that is fed from the sheet accommodating unit **12** and is transported along the transport path **30** is transported by the pair of positioning rollers **38** to the second transfer unit **37** in synchronization with the transfer of the individual toner images onto the intermediate transfer belt **64**. The toner images that have been transferred onto the intermediate transfer belt **64** are second transferred by the second transfer roller **89** onto the sheet of recording paper P transported to the second transfer unit **37**.

Subsequently, the sheet of recording paper P onto which the toner images have been transferred is transported to the fixing device **100**. In the fixing device **100**, the toner images are heated and pressed by the fixing roller **102** and the pressure roller **104**, thereby being fixed onto the sheet of recording paper P. Furthermore, the sheet of recording paper P onto which the toner images have been fixed is output from the output unit **16** to the lower table **52** or the upper table **56**. In the case of forming images on both sides of the sheet of recording paper P, an image is fixed onto the front surface of the sheet by the fixing device **100**, and the trailing end of the sheet is fed from the pair of transport rollers **96** to the duplex-printing transport path **94** and to the pair of positioning rollers **38** (transport path **30**), so that the leading end and the trailing end of the sheet are changed. Then, an image is formed on and fixed onto the rear surface of the sheet.

In the image forming apparatus **10** according to the first exemplary embodiment, the length of a sheet of recording paper P to be transported is set by a user, as described above. Also, in the image forming apparatus **10**, an image is formed on the sheet of recording paper P accommodated in the accommodating unit corresponding to the set sheet length. However, if sheets of recording paper P having a sheet length not intended by the user are accommodated in the accommodating unit, an image formation process is performed on a sheet of recording paper P having a sheet length different from the sheet length set by the user. For example, if the length of a sheet of recording paper P that is being transported is smaller than the sheet length set by the user, toner may be applied to a region where no sheet exists, so that the inside of the image forming unit **14** may become dirty unnecessarily. In order to avoid the occurrence of such a situation, passing of a sheet of recording paper P may be detected at the inlet of the transport path **30** to measure the sheet length, and it may be determined whether or not the sheet length is a sheet length intended by the user. Accordingly, the occurrence of a situation in which an image formation process is performed on a sheet of recoding paper P having an unintended sheet length is prevented. However, for example, if sheets of recording paper P are not fed one by one by the feed roller **32**, a sheet of recording paper P may be fed to the transport path **30** in the state of being partially overlapped on the preceding sheet. The cause of such overlap may be, for example, burrs caused by punching a hole in the recording paper P using a puncher, static electricity on the recording paper P, or an adhesive (for example, glue) that is adhered to the recording paper P in an unintended manner. If a sheet of recording paper P is transported in the state of being partially overlapped on the subsequent sheet due to such a cause, a wrong determination may be made in which a sheet of recording paper P having a length intended by the user (sheet length set by the user) is being transported, although the sheet length is actually different from that intended by the user. Also, another wrong determination may be made in which a sheet of recording paper P having a length intended by the user is not being transported, although the sheet length is actually the sheet length intended by the user.

Accordingly, in the image forming apparatus **10** according to this exemplary embodiment, a sheet length identification process is performed in which it is identified with high accuracy whether or not the length of a sheet of recording paper P that is currently being transported is a sheet length set by a user.

Hereinafter, the operation of the image forming apparatus **10** during the execution of the sheet length identification process will be described with reference to FIGS. **5**A and **5**B. FIGS. **5**A and **5**B illustrate a flowchart of an example of a process of a sheet length identification process program executed by the CPU **150** when the rotation of the feed roller **32** corresponding to the fourth accommodating unit **28** is started in order to take a sheet of recording paper P accommodated in the fourth accommodating unit **28** and to feed the sheet to the branch chute **31**B_4. The sheet length identification process program is stored in advance in a predetermined storage region of the ROM **152**. Here, in order to avoid complexity, a description will be given of a case where the sheet length identification process program is executed in a state where the rotation of the pair of positioning rollers **38** and the rollers disposed along the transport path **30** is stopped.

Referring to FIGS. **5**A and **5**B, in step **200**, it is determined whether or not the first path sensor **91**A has shifted from an OFF-state to an ON-state. If a positive determination is made, the process proceeds to step **202**. If a negative determination is made, the process proceeds to step **238**. In step **238**, it is determined whether or not a predetermined condition is satisfied. The predetermined condition is a condition for determining that a sheet of recording paper P having a predetermined sheet length is not being transported (for example, one second has passed from the start of the execution of step **200**). If a negative determination is made, the process returns to step **200**. If a positive determination is made, the process proceeds to step **232**.

In step **202**, the process waits until the leading end of a sheet of recording paper P fed to the chute **31** by the feed roller **32** comes into contact with the pair of positioning rollers **38** and the sheet forms bending of a predetermined degree (bending for correcting skew), that is, until 0.5 seconds have elapsed from the start of the rotation of the feed roller **32**. Then, the process proceeds to step **203**, where the rotation of the feed roller **32** is stopped, and the process proceeds to step **204**.

In step **204**, a transport start process is performed. Now, the operation of the image forming apparatus **10** during the execution of the transport start process will be described with reference to FIG. **6**. FIG. **6** is a flowchart illustrating an example of the process of a transport start process program executed by the CPU **150**. The transport start process program is stored in advance in a predetermined storage region of the ROM **152**.

In step **204**A in FIG. **6**, it is determined whether or not the assist function operation conditions are satisfied. If a positive determination is made, the process proceeds to step **204**B. If a negative determination is made, the process proceeds to step **204**C. In step **204**B, the assist function is operated, and the rotation of the rollers disposed along the transport path **30** is started. Then, the transport start process program is ended, and the process proceeds to step **206** of the sheet length identification process program. On the other hand, in step **204**C, the rotation of the individual rollers disposed along the transport path **30** is started, thereby starting transport of a sheet of recording paper P. Then, the transport start process program is ended, and the process proceeds to step **206** of the sheet length identification process program.

In step **206** in FIG. **5**A, measuring the time is started. Then, the process proceeds to step **208**, where it is determined whether or not the first path sensor **91**A has shifted from the ON-state to the OFF-state. If a positive determination is made, the process proceeds to step **210**. If a negative determination is made, the process proceeds to step **240**. In step **240**, it is determined whether or not a predetermined condition is satisfied. The predetermined condition is a condition for determining that a sheet of recording paper P having a predetermined sheet length is not being transported (for example, one second has passed from the start of measurement of the time in step **206**). If a negative determination is made, the process returns to step **208**. If a positive determination is made, the process proceeds to step **232**.

In step **210**, the measurement of the time started in step **206** is stopped. In step **212**, the length of the sheet of recording paper P that is currently being transported is estimated on the basis of the time measured in steps **206** and **210**, and then the process proceeds to step **214**. In step **212**, the sheet length is estimated by using the following equation (1). Alternatively, the sheet length may be estimated by obtaining the sheet length by using a look-up table to which the time measured in steps **206** and **210** is input and from which the sheet length is output.

$$\text{Sheet length (mm)}=V\times(T1-\alpha)+A \quad (1)$$

Here, T**1** (sec) represents the time measured (the elapsed time from step **206** to step **210**), V (mm/sec) represents the transport speed of a sheet of recording paper P, A (mm) represents the distance from a position of the pair of positioning rollers **38** where the leading end of a sheet of recording paper P comes into contact (nip portion) to a detection position of the first path sensor **91**A, and a (sec) represents a waiting time until transport restarts (for example, the sum of a time period in which the rotation of the feed roller **32** temporarily stops, and a time period from when an instruction to operate the pair of positioning rollers **38** is provided to when the pair of positioning rollers **38** are actually operated).

In step **214**, it is determined whether or not the sheet length estimated in step **212** is out of an assumed range. If a positive determination is made, the process proceeds to step **216**, where a flag indicating that the length of the sheet of recording paper P that is currently being transported is out of the assumed range is set (to an ON-state), and the process proceeds to step **218**. If a negative determination is made in step **214**, step **216** is skipped and the process proceeds to step **218**. Here, the "length out of the assumed range" is determined in view of an error of ±1 mm if the size of a sheet of recording paper P specified as a target to be transported is A3SEF, for example.

In step **218**, it is determined whether or not the second path sensor **91**B has shifted from the OFF-state to the ON-state. If a positive determination is made, the process proceeds to step **220**. If a negative determination is made, the process proceeds to step **242**. In step **242**, it is determined whether or not a predetermined condition is satisfied. The predetermined condition is a condition for determining that a sheet of recording paper P having a predetermined sheet length is not being transported (for example, 0.5 seconds have passed since the second path sensor **91**B shifted from the ON-state to the OFF-state). If a negative determination is made, the process returns to step **218**. If a positive determination is made, the process proceeds to step **232**.

In step **220**, measurement of time is started. Then, the process proceeds to step **222**, where it is determined whether or not the second path sensor **91**B has shifted from the ON-state to the OFF-state. If a positive determination is made, the process proceeds to step **224**. If a negative determination is made, the process proceeds to step **244**. In step **244**, it is determined whether or not a predetermined condition is satisfied. The predetermined condition is a condition for determining that a sheet of recording paper P having a predetermined sheet length is not being transported (for example, one second has passed from the start of measurement of time in step **220**). If a negative determination is made, the process returns to step **222**. If a positive determination is made, the process proceeds to step **232**.

In step **224**, the measurement of time started in step **220** is stopped. In step **226**, the length of the sheet of recording paper P that is currently being transported is estimated on the basis of the measured time, and the process proceeds to step **228**.

In step **228**, it is determined whether or not the sheet length estimated in step **226** is out of the assumed range. If a positive determination is made, the process proceeds to step **230**, where a flag indicating that the length of the sheet of recording paper P that is currently being transported is out of the assumed range is set (to an ON-state), and then the process proceeds to step **232**.

In step **232**, an alarm signal indicating that the length of the sheet of recording paper P that is currently being transported is out of the assumed range is output, and then the process proceeds to step **234**. The alarm signal is output to the UI panel **158**, for example. When receiving the alarm signal, the UI panel **158** displays a message indicating that the length of the sheet of recording paper P that is currently being transported is out of the assumed range. An example of the message may be "The set sheets have a size different from the specified size.", "The specified sheet is not being transported.", or "Please set the sheet size again." Instead of displaying a visible message on the UI panel **158**, an audible message may be output from a speaker, or a message may be printed on paper so that the message may be permanently visible. Alternatively, some of display of a visible message, output of an audible message, and permanent display of a message may be used together. Alternatively, an alarm signal may be transmitted to the external apparatus **162** via the external interface **160**.

If a negative determination is made in step **228**, steps **230** and **232** are skipped, and the process proceeds to step **234**. In step **234**, it is determined whether or not there is a roller that is rotating among the feed roller **32** and the rollers disposed along the transport path **30**. If a negative determination is made, the sheet length identification process program ends. If a positive determination is made, the process proceeds to step **236**, where the rotation of rollers is stopped to stop the transport operation, and then the sheet length identification process program ends.

As described above in detail, in the image forming apparatus **10** according to the first exemplary embodiment, the length of a sheet of recording paper P is estimated on the basis of individual detection results generated by the respective first path sensor **91**A and second path sensor **91**B disposed along the transport path **30**, and an alarm signal is output if the sheet length estimated on the basis of at least one of the detection results is not a predetermined length. Accordingly, whether or not the length of the transported sheet of recording paper P is the predetermined length is identified with high accuracy, compared to a case where the image forming apparatus **10** does not have the above-described configuration.

Second Exemplary Embodiment

In the first exemplary embodiment, a description has been given of the sheet length identification process in a case where a sheet of recording paper P accommodated in the fourth accommodating unit **28** is taken from the fourth accommodating unit **28** and is fed to the transport path **30**. In a second exemplary embodiment, a description will be given of a case where any one of the first to fourth accommodating units **22**, **24**, **26**, and **28** is specified, and a sheet of recording paper P is taken by the feed roller **32** from the specified accommodating unit and is fed to the transport path **30**. The elements described above in the first exemplary embodiment are denoted by the same reference numerals, and the corresponding description will be omitted. Hereinafter, the points different from the first exemplary embodiment will be described.

In the image forming apparatus **10** according to the second exemplary embodiment, a sheet of recording paper P that is taken by the feed roller **32** from an accommodating unit and is fed to the transport path **30** may be fed while being overlapped on the subsequent sheet of recording paper P due to burrs or static electricity, for example. However, in the image forming apparatus **10** according to the second exemplary embodiment, the pairs of transport rollers **36** are provided for the respective first to third accommodating units **22**, **24**, and **26**. Thus, even if a sheet of recording paper P is taken by the feed roller **32** from any one of the first to third accommodating units **22**, **24**, and **26** and is fed to the transport path **30** while being overlapped on the subsequent sheet of recording paper P, the overlapped sheet may be separated by the pair of transport rollers **36**. Accordingly, a sheet of recording paper P that is taken by the feed roller **32** from any one of the first to third accommodating units **22**, **24**, and **26** and is fed to the transport path **30** is less likely to be transported while being overlapped on the subsequent sheet of recording paper P, compared to a sheet of recording paper P that is taken by the feed roller **32** from the fourth accommodating unit **28** and is fed to the transport path **30**.

As described above, if there is a path along which a sheet is less likely to be transported while being overlapped on another sheet, a sufficient accuracy of identifying each sheet of recording paper P is ensured for the sheets of recording paper P that are transported along the path, even if an estimation result of a sheet length obtained on the basis of the detection results generated by the first and second path sensors **91**A and **91**B is not used, unlike in the above-described first exemplary embodiment.

In the image forming apparatus **10** according to the second exemplary embodiment, a sheet length identification process according to an accommodating unit is performed, in which either of two estimation methods is used. One of the two estimation methods is a method for estimating the length of a sheet of recording paper P that is taken by the feed roller **32** from any one of the first to third accommodating units **22**, **24**, and **26** and is fed to the transport path **30**. The other is a method for estimating the length of a sheet of recording paper P that is taken by the feed roller **32** from the fourth accommodating unit **28** and is fed to the transport path **30**.

Hereinafter, the operation of the image forming apparatus **10** during the execution of the sheet length identification process according to an accommodating unit will be described with reference to FIGS. **7**A and **7**B. FIGS. **7**A and **7**B illustrate a flowchart of an example of a process of a sheet length identification process program according to an accommodating unit executed by the CPU **150** when the rotation of the feed roller **32** corresponding to a specified accommodating unit is started in order to take a sheet of recording paper P accommodated in the specified accommodating unit and feed the sheet to the transport path **30**. The sheet length identification process program according to an accommodating unit is stored in advance in a predetermined storage region of the ROM **152**. Here, in order to avoid complexity, a description will be given of a case where any one of the first to fourth accommodating units **22**, **24**, **26**, and **28** is already specified as an accommodating unit that accommodates sheets of recording paper P to be transported. Also, a description will be given of a case where the sheet length identification process program according to an accommodating unit is executed in a state where the rotation of the pair of positioning rollers **38** and the rollers disposed along the transport path **30** is stopped.

Referring to FIGS. **7**A and **7**B, in step **400**, it is determined whether or not the accommodating unit that is currently specified is provided with the pair of transport rollers **36** corresponding thereto. If a negative determination is made, the process proceeds to step **402**, where the sheet length identification process program described above in the first exemplary embodiment is executed, and the sheet length identification process program according to an accommodating unit ends.

On the other hand, if a positive determination is made in step **400**, the process proceeds to step **404**. In step **404**, a step corresponding to the above-described step **200** is performed. If a negative determination is made in step **404**, the process proceeds to step **406**, a step corresponding to the above-described step **238** is performed. If a positive determination is made in step **404**, the process proceeds to step **408**. In step **408**, a step corresponding to the above-described step **202** is performed, and then the process proceeds to step **410**. In step **410**, a step corresponding to the above-described step **203** is performed, and then the process proceeds to step **412**. In step **412**, a step corresponding to the above-described step **204** is performed, and then the process proceeds to step **414**. In step **414**, a step corresponding to the above-described step **206** is performed, and then the process proceeds to step **416**. In step **416**, a step corresponding to the above-described step **208** is performed. If a negative determination is made in step **416**, the process proceeds to step **418**, where a step corresponding to the above-described step **240** is performed.

On the other hand, if a positive determination is made in step **416**, the process proceeds to step **420**, where a step corresponding to the above-described step **210** is performed, and then the process proceeds to step **422**. In step **422**, a step corresponding to the above-described step **212** is performed, and then the process proceeds to step **424**. In step **424**, it is determined whether or not the sheet length estimated in step

422 is out of an assumed range. If a positive determination is made, the process proceeds to step **426**. In step **426**, a step corresponding to the above-described step **232** is performed, and then the process proceeds to step **428**.

On the other hand, if a negative determination is made in step **424**, the process proceeds to step **428**. In step **428**, a step corresponding to the above-described step **234** is performed, and then the process proceeds to step **430**. In step **430**, a step corresponding to the above-described step **236** is performed, and then the sheet length identification process program according to an accommodating unit ends.

As a result of executing the sheet length identification process according to an accommodating unit, a sheet length is estimated with high accuracy when a sheet of recording paper P is taken from any one of the accommodating units and is fed to the transport path **30**. Also, as for a sheet of recording paper P that is taken from any one of the first to third accommodating units **22**, **24**, and **26** and is fed to the transport path **30**, the sheet length thereof is estimated on the basis of a detection result generated by the first path sensor **91**A, not on the basis of a detection result generated by the second path sensor **91**B. Thus, the load of estimation is decreased compared to the case of estimating the sheet length using the detection results generated by both the first and second path sensors **91**A and **91**B. Also, the time for estimation is shortened.

In the image forming apparatus **10** according to the second exemplary embodiment, when the assist function operation conditions are satisfied, the assist function operates even though a sheet length specified as the length of sheets of recording paper P to be transported is equal to or larger than a predetermined sheet length and even though sheets of recording paper P having a length shorter than the specified sheet length are accommodated in the accommodating unit that is to accommodate sheets of recording paper P of the specified sheet length. However, in a path provided with the pair of transport rollers **36**, plural sheets of recording paper P that are fed by being overlapped are more likely to be separated from each other while being transported, compared to a path not provided with the pair of transport rollers **36**. Thus, whether or not the length of a sheet of recording paper P transported along the transport path **30** is within an assumed range is identified with high accuracy on the basis of a detection result generated by the first path sensor **91**A, not using a detection result generated by the second path sensor **91**B.

In the above-described exemplary embodiments, a description has been given of a case where a sheet of recording paper P accommodated in an accommodating unit is transported. Alternatively, the exemplary embodiments may be applied to a case where a sheet of recording paper P held by the foldable manual sheet feeder **39** is transported. In the example illustrated in FIG. **1**, if sheets of recording paper P held by the foldable manual sheet feeder **39** are taken by the feed roller **42** and are fed to the auxiliary transport path **40** while being overlapped each other, the sheets are likely to be separated from each other by the two pairs of transport rollers **44** provided along the path leading to the pair of positioning rollers **38**. Thus, in the sheet length identification process program according to an accommodating unit illustrated in FIGS. **7**A and **7**B, a positive determination is made in step **400**, and steps **404** to **430** are performed.

In the above-described exemplary embodiments, a description has been given of the case of estimating a sheet length on the basis of an elapsed time from the execution of the transport start process. Alternatively, a sheet length may be estimated on the basis of the time period from when the first path sensor **91**A shifts from the ON-state to the OFF-state to when the first path sensor **91**A shifts to the ON-state again.

In the above-described exemplary embodiments, a description has been given of a case where two sensors, that is, the first path sensor **91**A and the second path sensor **91**B, are provided along the transport path **30**. Alternatively, three or more path sensors may be provided along the transport path **30**. In that case, sheet lengths are estimated on the basis of detection results generated by the three sensors. If at least one of the estimated sheet lengths is out of an assumed range, an alarm signal is output. If all the estimated sheet lengths are within the assumed range, an alarm signal is not output. Accordingly, whether or not a sheet of recording paper P having a preset sheet length is being transported is determined more accurately.

In the second exemplary embodiment, a description has been given of a case where passing of a sheet of recording paper P taken from the accommodating unit with which the pair of transport rollers **38** is associated is detected by using the first path sensor **91**A disposed on the upstream side in the transport direction among the first path sensor **91**A and the second path sensor **91**B. Alternatively, passing of the sheet may be detected by using the second path sensor **91**B disposed on the downstream side in the transport direction. In this case, the sheet of recording paper P passes the second transfer unit **37** and the fixing device **100** before reaching the detection region of the second path sensor **91**B. Thus, even if plural sheets of recording paper P are transported there while being overlapped each other, the sheets are likely to be separated from each other when passing the second transfer unit **37** and the fixing device **100**. Therefore, in the case of estimating a sheet length by using a detection result generated by the second path sensor **91**B, whether or not a sheet of recording paper P having a preset sheet length is being transported is determined more accurately than in the case of estimating a sheet length by using a detection result generated by the first path sensor **91**A, which is positioned on the upstream side in the transport direction with respect to the second path sensor **91**B. On the other hand, in the case of estimating a sheet length by using a detection result generated by the first path sensor **91**A, whether or not a sheet of recording paper P having a preset sheet length is being transported is determined more quickly than in the case of estimating a sheet length by using a detection result generated by the second path sensor **91**B, which is positioned on the downstream side in the transport direction with respect to the first path sensor **91**A.

In the above-described exemplary embodiments, a sheet of recording paper P is transported. Alternatively, an overhead projector (OHP) sheet or a color filter used for manufacturing a liquid crystal display may be transported. That is, any type of sheet may be transported as long as an image may be formed thereon.

In the above-described exemplary embodiments, various process programs are stored in advance in the ROM **152**. Alternatively, the various process programs may be provided in the form of being stored in a computer readable storage medium, such as a compact disc-read only memory (CD-ROM), a digital versatile disc-read only memory (DVD-ROM), or a universal serial bus (USB) memory. Alternatively, the various process programs may be distributed via a wired or wireless communication medium.

The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. A sheet identification device comprising:

a plurality of detecting units that are provided along a transport path along which a sheet is transported by a transport unit and that detect passing of the sheet;

an estimating unit that performs a plurality of estimates of a length in a transport direction of the sheet as a detection target, each estimate based on detection results generated by a respective one of the detecting units; and

an output unit that outputs, if at least one of the estimated lengths is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported.

2. The sheet identification device according to claim 1, wherein:

the plurality of detecting units comprise a first path sensor and a second path sensor,

the estimation unit performs a first estimate of the length of the sheet based on detection results generated by the first path sensor, and a second estimate of the length of the sheet based on detection results generated by the second path sensor, and

the output unit outputs the signal when at least one of the first estimate and the second estimate is not the predetermined length.

3. The sheet identification device according to claim 2, wherein the second path sensor is located downstream of the first path sensor in the transport path.

4. The sheet identification device according to claim 1, wherein each estimate is determined based on a time measured between detection results of the respective detecting unit.

5. A sheet identification device comprising:

a plurality of detecting units that are provided along a transport path along which a sheet is transported by a transport unit and that detect passing of the sheet;

an estimating unit that estimates a length in a transport direction of the sheet as a detection target on the basis of individual detection results generated by the plurality of detecting units;

an output unit that outputs, if the length estimated by the estimating unit on the basis of at least one of the detection results is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported;

a feed unit that takes a sheet accommodated in an accommodating unit from the accommodating unit and feeds the sheet to the transport path; and

a controller that controls the feed unit so that, if a length through which transport is to be assisted by the feed unit is preset as a length in the transport direction of a sheet to be transported, a feed operation is performed on the sheet until a predetermined time period elapses from when the feed unit starts feeding the sheet to a specific region of the transport path, the predetermined time period being a time period for feeding the sheet by the preset length.

6. A sheet identification device comprising:

a plurality of detecting units that are provided along a transport path along which a sheet is transported by a transport unit and that detect passing of the sheet;

an estimating unit that estimates a length in a transport direction of the sheet as a detection target on the basis of individual detection results generated by the plurality of detecting units;

an output unit that outputs, if the length estimated by the estimating unit on the basis of at least one of the detection results is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported;

a plurality of feed units that correspond to a plurality of accommodating units in which sheets to be transported are accommodated, that take the sheets accommodated in the plurality of accommodating units from the plurality of accommodating units, and that feed the sheets to the transport path, the transport unit including a positioning unit that performs positioning of the sheets fed by the plurality of feed units and that feeds the sheets to a specific region of the transport path; and

a supplying unit that corresponds to at least one of the plurality of accommodating units, that receives a sheet fed by a corresponding one of the plurality of feed units, and that feeds the received sheet to the positioning unit, thereby supplying the sheet to the positioning unit,

wherein the estimating unit estimates, if the supplying unit corresponds to one of the plurality of accommodating units from which the sheet has been taken by one of the plurality of feed units, a length in the transport direction of the sheet as a detection target on the basis of a detection result generated by one of the plurality of detecting units, and estimates, if the supplying unit does not correspond to one of the plurality of accommodating units from which the sheet has been taken by one of the plurality of feed units, a length in the transport direction of the sheet as a detection target on the basis of detection results generated by the plurality of detecting units.

7. The sheet identification device according to claim 6, wherein the estimating unit estimates, if the supplying unit corresponds to one of the plurality of accommodating units from which the sheet has been taken by one of the plurality of feed units, a length in the transport direction of the sheet as a detection target on the basis of a detection result generated by a detecting unit on an upstream side among the plurality of detecting units, and estimates, if the supplying unit does not correspond to one of the plurality of accommodating units from which the sheet has been taken by one of the plurality of feed units, a length in the transport direction of the sheet as a detection target on the basis of detection results generated by the plurality of detecting units.

8. The sheet identification device according to claim 6, wherein the estimating unit estimates, if the supplying unit corresponds to one of the plurality of accommodating units from which the sheet has been taken by one of the plurality of feed units, a length in the transport direction of the sheet as a detection target on the basis of a detection result generated by a detecting unit on a downstream side among the plurality of detecting units, and estimates, if the supplying unit does not correspond to one of the plurality of accommodating units from which the sheet has been taken by one of the plurality of feed units, a length in the transport direction of the sheet as a detection target on the basis of detection results generated by the plurality of detecting units.

9. An image forming apparatus comprising:

a sheet identification device comprising:

a plurality of detecting units that are provided along a transport path along which a sheet is transported by a transport unit and that detect passing of the sheet;

an estimating unit that estimates a length in a transport direction of the sheet as a detection target on the basis of individual detection results generated by the plurality of detecting units;

an output unit that outputs, if the length estimated by the estimating unit on the basis of at least one of the detection results is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported; and

an image forming unit that forms an image corresponding to image information on a sheet transported to the transport path by the transport unit.

10. A computer readable medium storing a program causing a computer to execute a process for controlling an image forming apparatus including a plurality of detecting units that are provided along a transport path along which a sheet is transported by a transport unit and that detect passing of the sheet, the process comprising:

performing a plurality of estimates of a length in a transport direction of the sheet as a detection target, each estimate based on detection results generated by a respective one of the detecting units; and

outputting, if at least one of the estimated lengths is not a predetermined length, a signal indicating that a sheet having a length in the transport direction different from the predetermined length is being transported.

11. The computer readable medium according to claim **10**, wherein:

the plurality of detecting units comprise a first path sensor and a second path sensor,

performing the plurality of estimates comprises performing a first estimate of the length of the sheet based on detection results generated by the first path sensor, and a second estimate of the length of the sheet based on detection results generated by the second path sensor, and

the outputting comprises outputting the signal when at least one of the first estimate and the second estimate is not the predetermined length.

12. The computer readable medium according to claim **11**, wherein the second path sensor is located downstream of the first path sensor in the transport path.

13. The computer readable medium according to claim **10**, wherein each estimate is determined based on a time measured between detection results of the respective detecting unit.

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